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(54) **SENSOR EQUIPPED MEDICINAL CONTAINER**

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(52) **U.S. Cl.**
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(Continued)

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USPC 340/540, 539.12, 547, 309.16, 407.1, 340/815.4, 384.1; 221/10
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,170,380 A 12/1992 Howard et al.
5,421,981 A 6/1995 Leader et al.
(Continued)

FOREIGN PATENT DOCUMENTS

WO 2009051476 A1 4/2009

OTHER PUBLICATIONS

ISA/US, International Search Report and Written Opinion dated Dec. 11, 2012, Int'l Appln No. PCT/US2012/059203, 8 pages.
(Continued)

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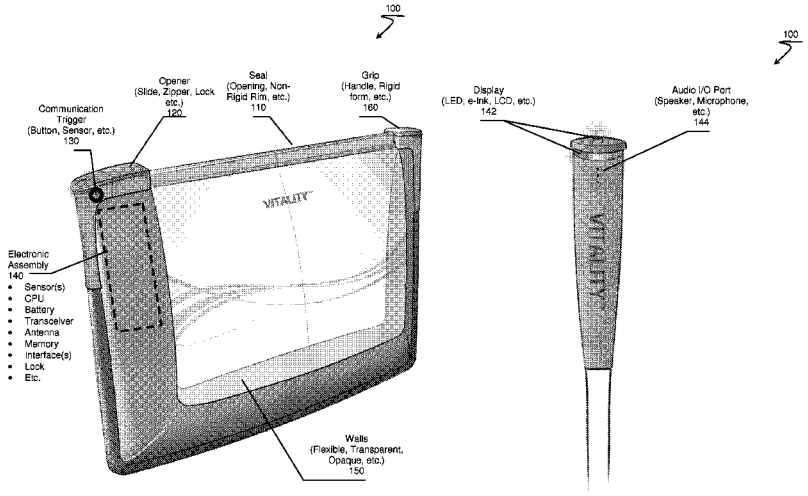
(57) **ABSTRACT**

Medicinal container bags are presented. Bags can include openers capable of sealing an opening of the bag. Disclosed bags further comprise electronic assemblies configured to detect opening or closing events as the openers move along the rims of the bag opening. The assemblies can compile usage data based on opener movement, and then provide the data to remote monitoring systems.

23 Claims, 9 Drawing Sheets



(51) **Int. Cl.**

G06F 19/00	(2011.01)
A61J 1/10	(2006.01)
A61J 1/18	(2006.01)
A61J 7/02	(2006.01)
A61J 1/14	(2006.01)

(52) **U.S. Cl.**

CPC ***G06F 19/3456*** (2013.01); *A61J 1/1412* (2013.01); *A61J 7/0418* (2015.05); *A61J 7/0436* (2015.05); *A61J 2007/0418* (2013.01); *A61J 2007/0436* (2013.01); *A61J 2200/30* (2013.01); *A61J 2205/20* (2013.01); *A61J 2205/60* (2013.01); *A61J 2205/70* (2013.01); *G06F 19/3462* (2013.01)

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,070,628	A	6/2000	Nastasi	
6,361,642	B1 *	3/2002	Bellamy et al.	156/245
6,529,446	B1	3/2003	de la Huerga	
7,198,172	B2	4/2007	Harvey et al.	
7,269,476	B2	9/2007	Ratnakar	
7,276,675	B2	10/2007	Faries, Jr. et al.	
7,295,890	B2	11/2007	Jean-Pierre	
7,350,669	B2 *	4/2008	Rani	222/92
7,406,259	B1 *	7/2008	Wilhelm	396/301
7,407,796	B2	8/2008	Hammerstedt et al.	
7,424,888	B2	9/2008	Harvey et al.	
7,715,277	B2	5/2010	de la Huerga	
7,801,745	B2	9/2010	Walker et al.	
7,844,361	B2	11/2010	Jean-Pierre	
7,978,564	B2	7/2011	de La Huerga	
8,378,812	B2 *	2/2013	Choi et al.	340/539.12
8,391,104	B2 *	3/2013	de la Huerga	368/10
2002/0104848	A1	8/2002	Burrows	
2003/0048187	A1 *	3/2003	Nolte	340/572.8
2007/0016443	A1	1/2007	Wachman et al.	
2007/0024465	A1	2/2007	Howell et al.	
2007/0073560	A1	3/2007	Walker et al.	
2008/0136629	A1	6/2008	Mahoney	
2008/0162192	A1 *	7/2008	Vonk et al.	705/3
2009/0043605	A1	2/2009	Imai et al.	
2009/0128330	A1	5/2009	Monroe	
2009/0134181	A1	5/2009	Wachman et al.	
2009/0195400	A1 *	8/2009	Oreshkin	340/686.1
2009/0294521	A1	12/2009	De La Huerga	
2010/0102930	A1	4/2010	McCoy	
2010/0270257	A1	10/2010	Wachman et al.	
2010/0328099	A1	12/2010	Wachman et al.	

OTHER PUBLICATIONS

PCT International Preliminary Report on Patentability in PCT International Application Serial No. PCT/US2012/059203 mailed on Apr. 8, 2014.

* cited by examiner

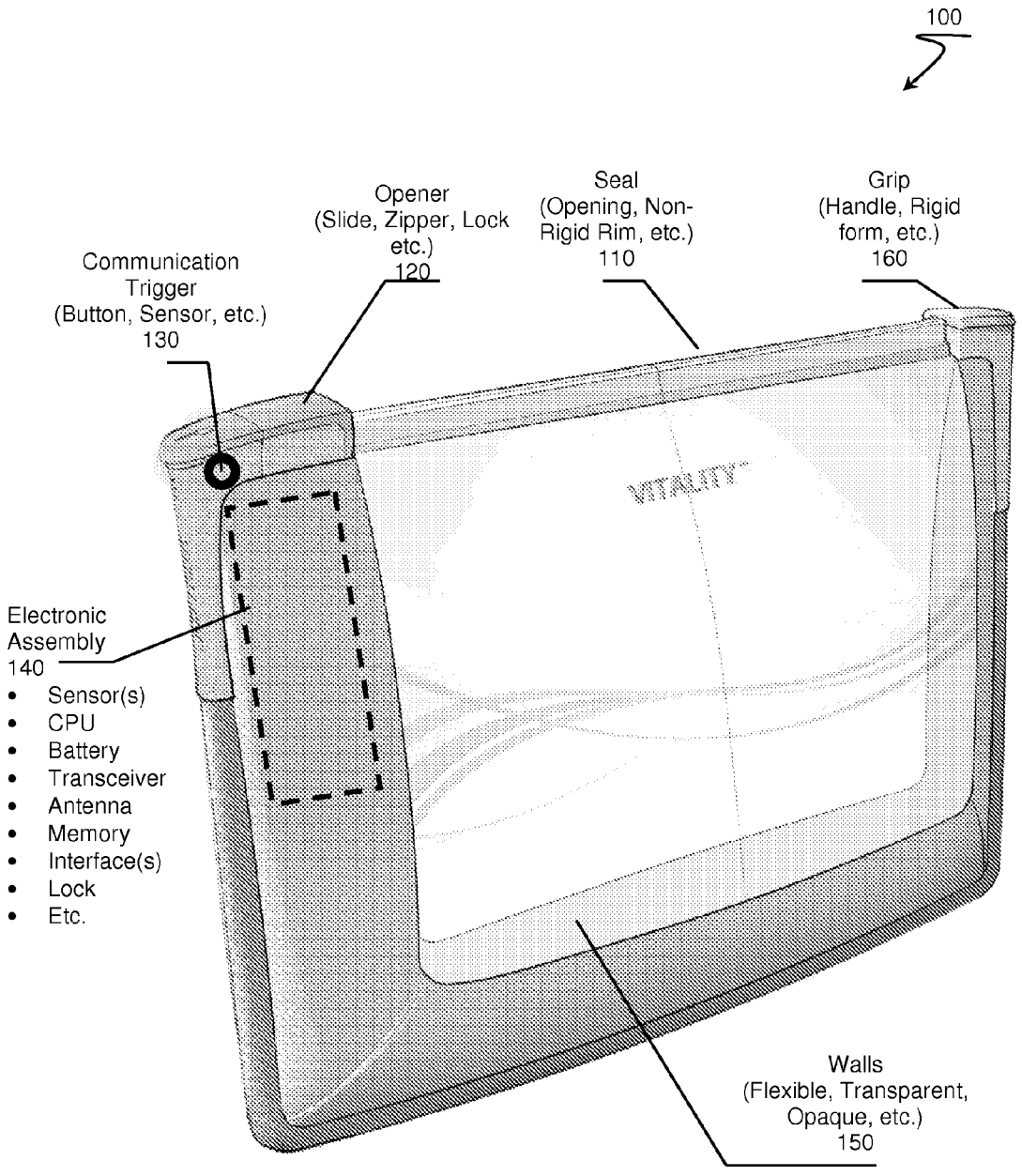

100
Opener
(Slide, Zipper, Lock
etc.)
120
Seal
(Opening, Non-
Rigid Rim, etc.)
110
Grip
(Handle, Rigid
form, etc.)
160
Communication
Trigger
(Button, Sensor, etc.)
130
VITALITY
Electronic
Assembly
140
• Sensor(s)
• CPU
• Battery
• Transceiver
• Antenna
• Memory
• Interface(s)
• Lock
• Etc.
Walls
(Flexible, Transparent,
Opaque, etc.)
150

Figure 1A

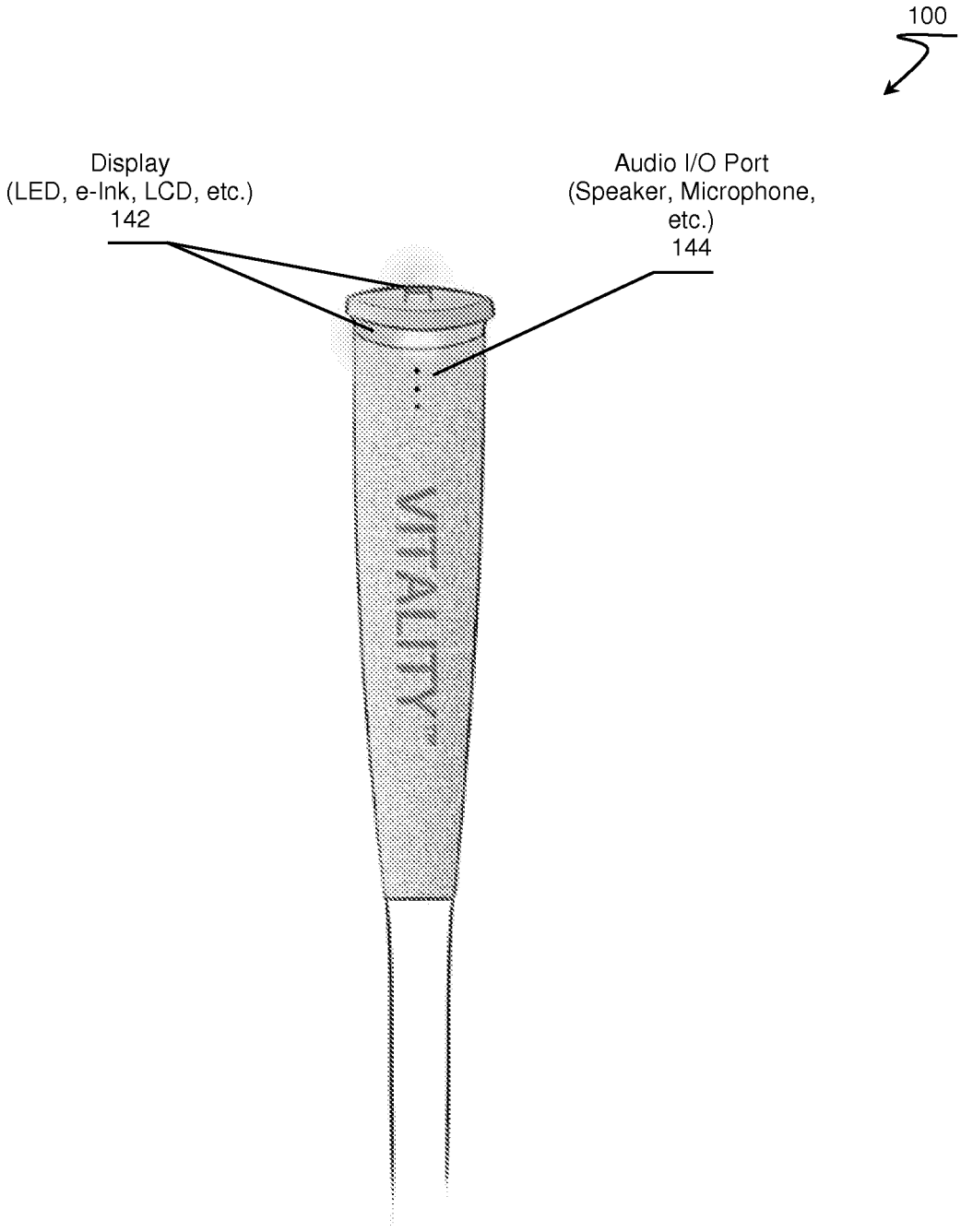

100
Display
(LED, e-Ink, LCD, etc.)
142
Audio I/O Port
(Speaker, Microphone,
etc.)
144

Figure 1B

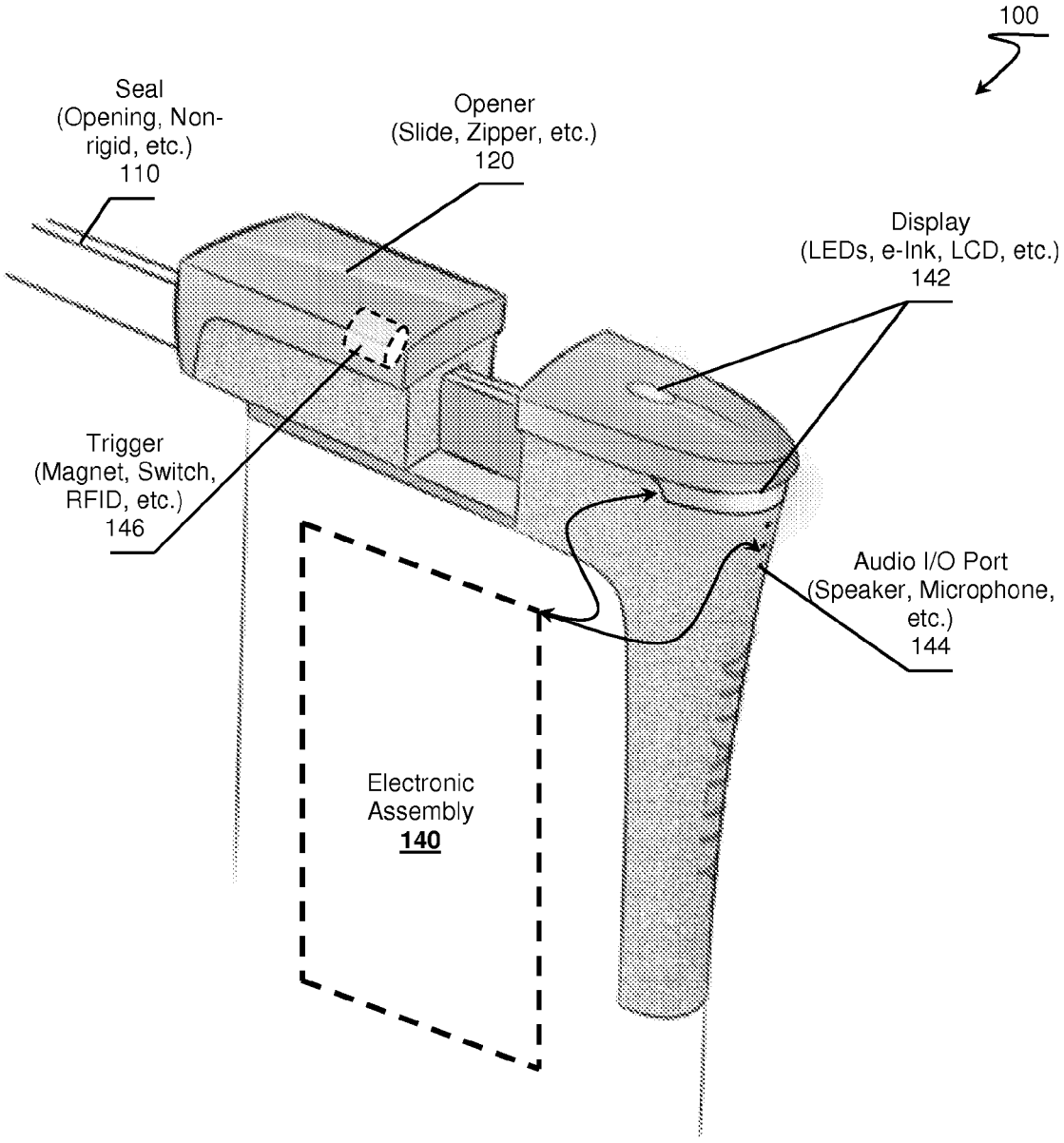

100
Seal
(Opening, Non-rigid, etc.)
110
Opener
(Slide, Zipper, etc.)
120
Display
(LEDs, e-Ink, LCD, etc.)
142
Trigger
(Magnet, Switch, RFID, etc.)
146
Audio I/O Port
(Speaker, Microphone, etc.)
144
Electronic Assembly
140

Figure 1C

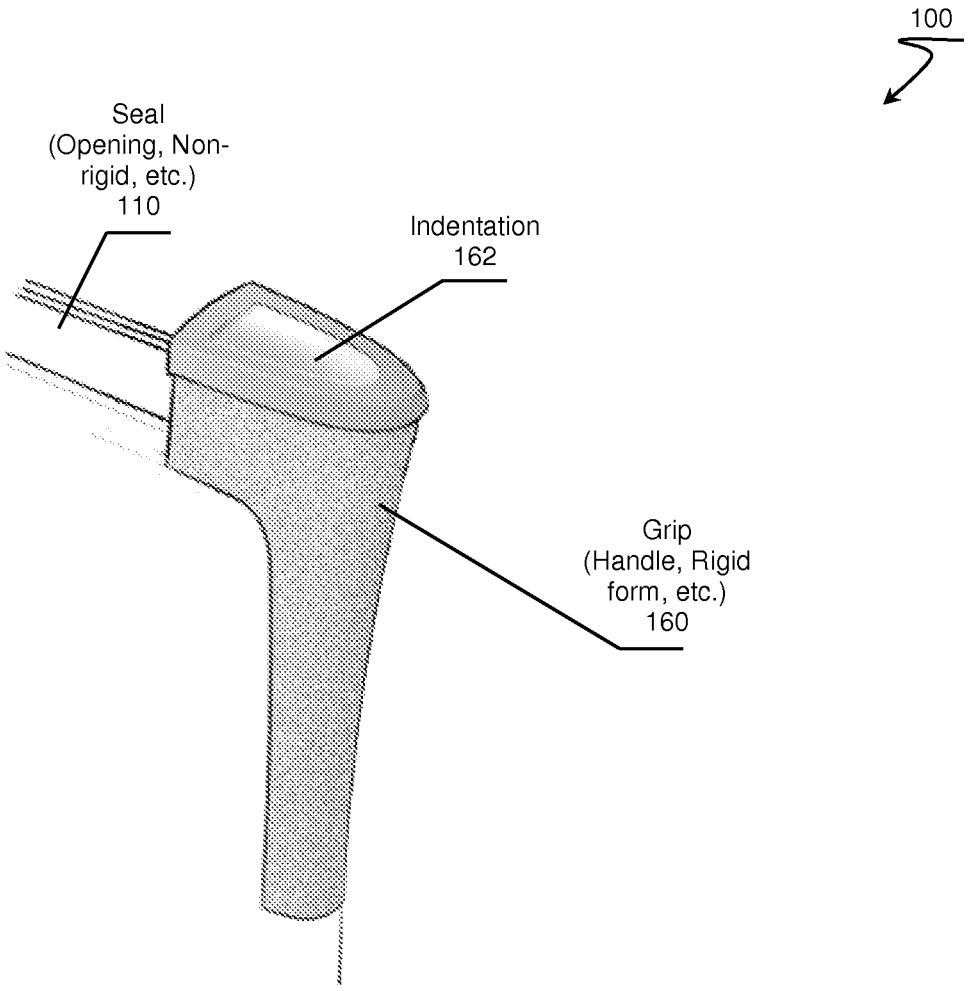

100
Seal
(Opening, Non-
rigid, etc.)
110
Indentation
162
Grip
(Handle, Rigid
form, etc.)
160

Figure 1D

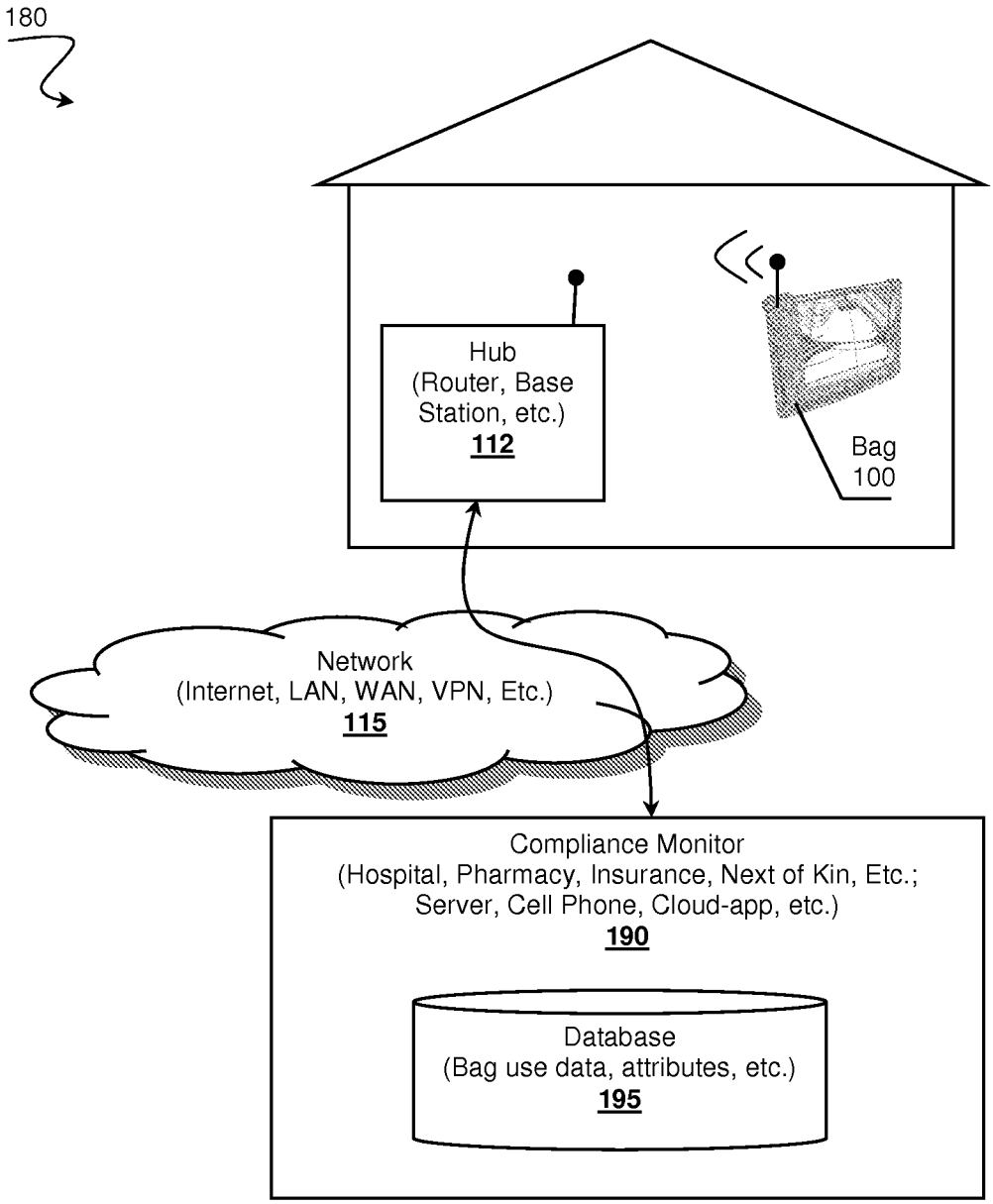

180
Hub
(Router, Base
Station, etc.)
112
Bag
100
Network
(Internet, LAN, WAN, VPN, Etc.)
115
Compliance Monitor
(Hospital, Pharmacy, Insurance, Next of Kin, Etc.;
Server, Cell Phone, Cloud-app, etc.)
190
Database
(Bag use data, attributes, etc.)
195

Figure 1E

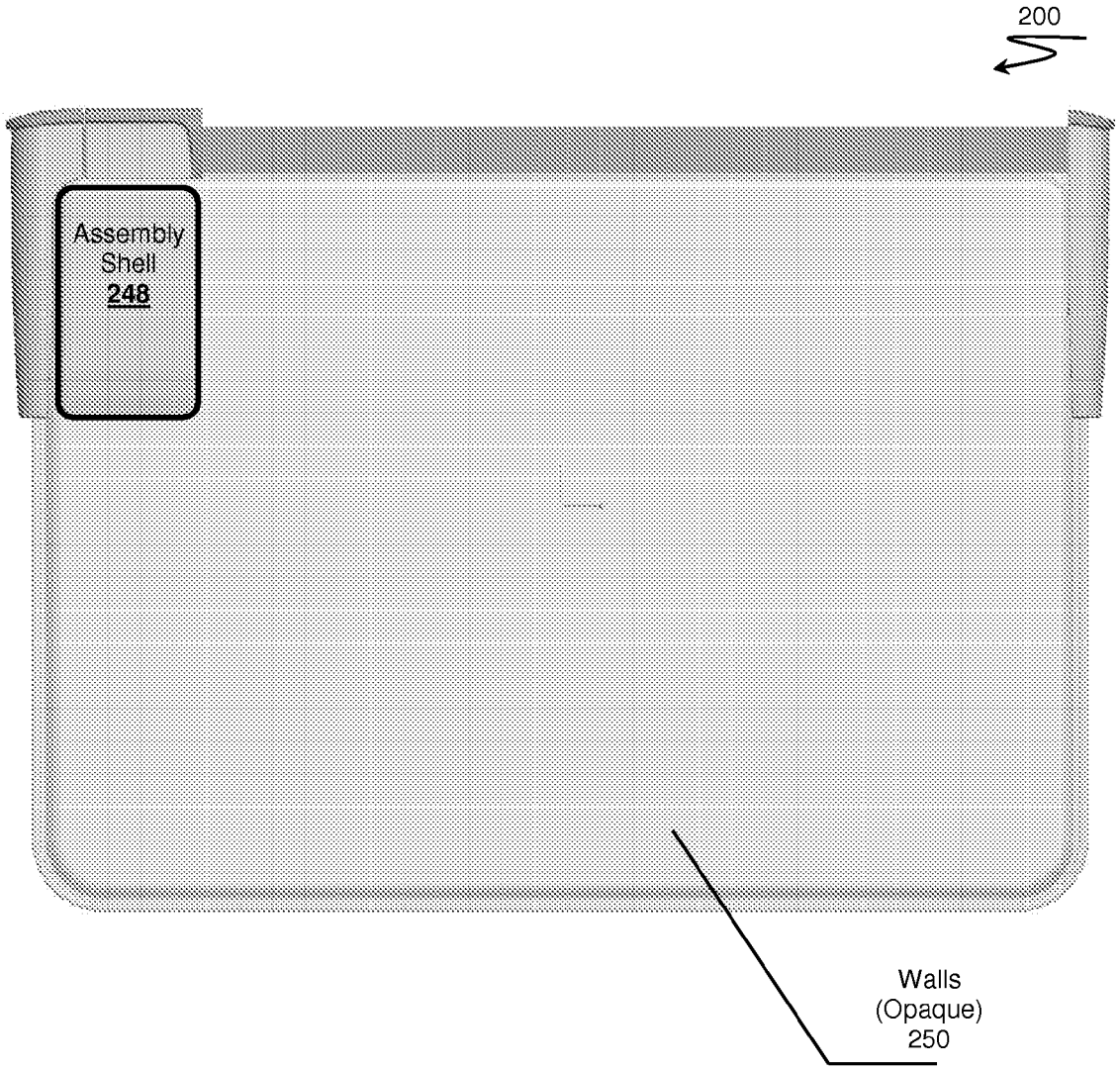


Figure 2A

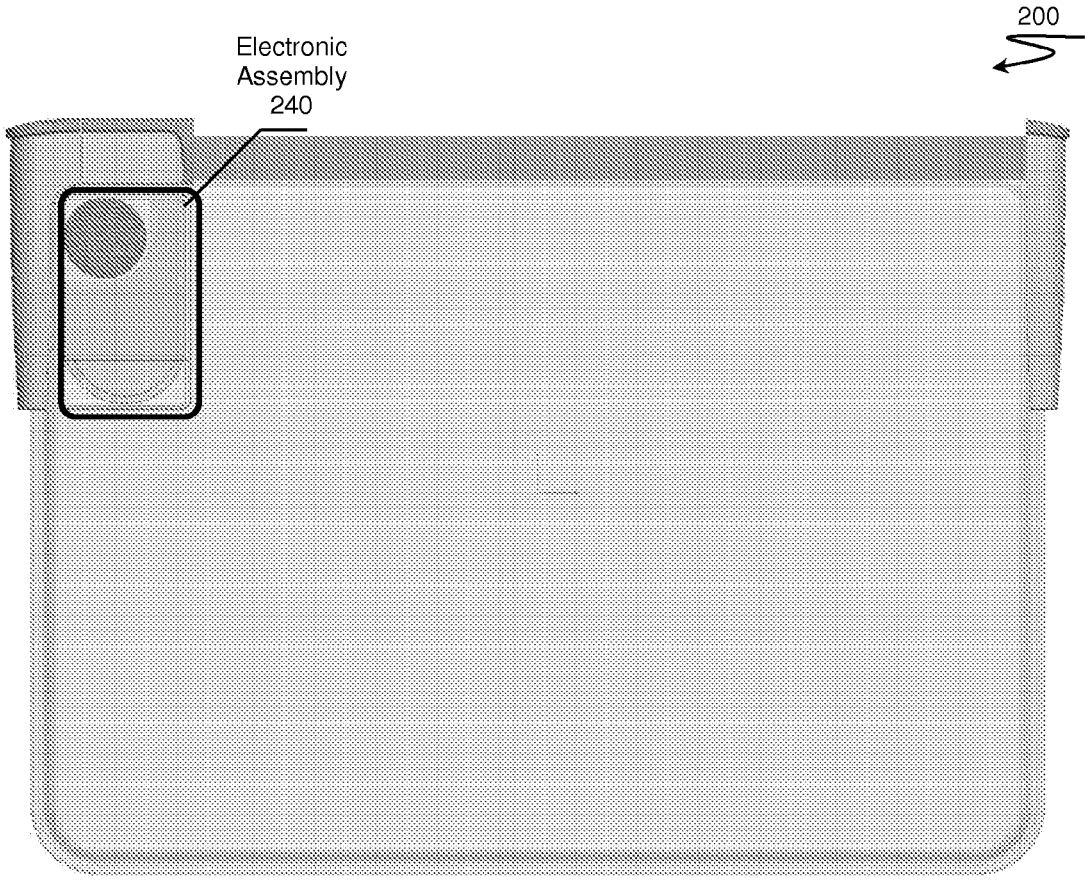


Figure 2B

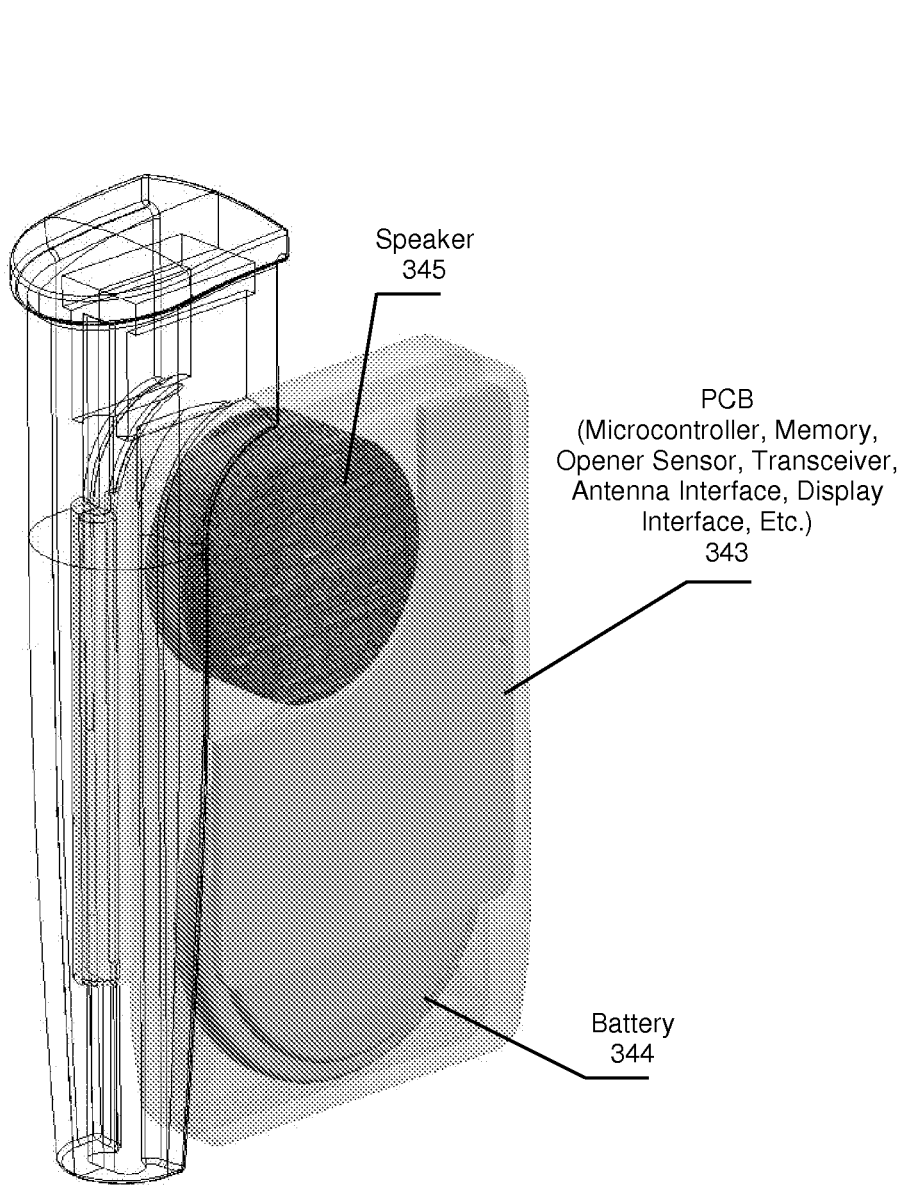

340
Speaker
345
PCB
(Microcontroller, Memory,
Opener Sensor, Transceiver,
Antenna Interface, Display
Interface, Etc.)
343
Battery
344

Figure 3

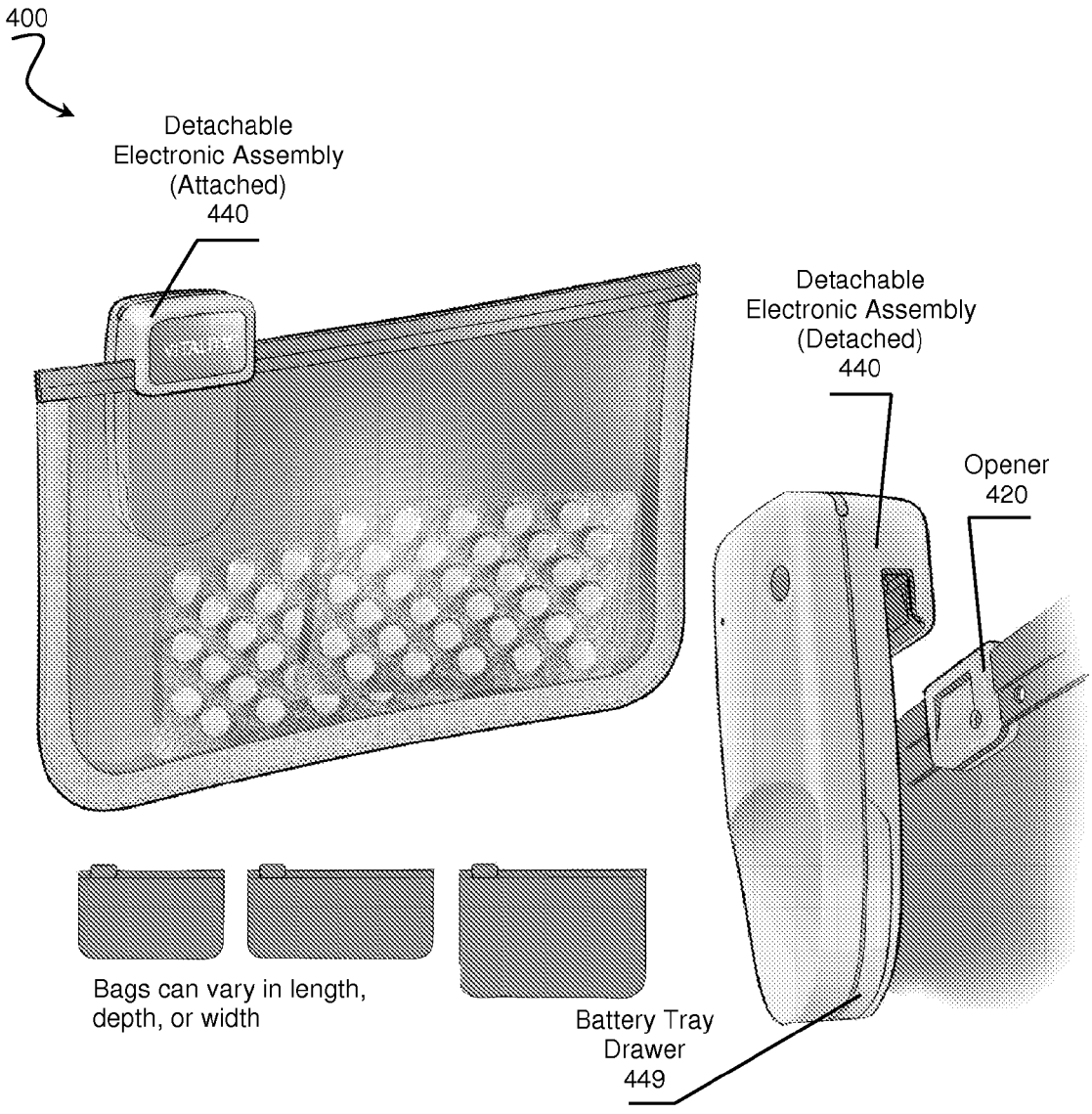

400
Detachable
Electronic Assembly
(Attached)
440
Detachable
Electronic Assembly
(Detached)
440
Opener
420
Bags can vary in length,
depth, or width
Battery Tray
Drawer
449

Figure 4

SENSOR EQUIPPED MEDICINAL CONTAINER

This application claims the benefit of priority to U.S. provisional application having Ser. No. 61/543,945 filed on Oct. 6, 2011.

FIELD OF THE INVENTION

The field of the invention is medical container technologies.

BACKGROUND

Ensuring a patient follows a medication or dosage regime continues to be problematic in the medical industry. Previous efforts directed toward compliance focused on incorporating reminders into various medicinal containers. For example, U.S. patent application publication 2007/0016443 to Wachman et al. titled "Medication Compliance Systems, Methods and Devices with Configurable and Adaptable Escalation Engine", filed Jul. 6, 2006, describes incorporating electronics into a container cap where the electronics can provide compliance feedback to a patient or to remote healthcare providers. Interestingly, the disclosed effort and other known efforts focus on specific containers; bottles, vials, boxes, or blister packs for example, rather than a single container, a bag for example, suitable for all types of pharmaceuticals. Further, the known art fails to address issues that arise from bag-like containers having flexible seals, which render detection of an open or close event very difficult.

U.S. patent application publication 2002/00104848 to Burrows et al. titled "Pharmaceutical Container Having Signaling Means and Associated Method of Use", filed Feb. 5, 2001, describes a use of a sensor to determine the closed position of a cap. Contemplated containers transmit data with a base station. Although Burrows presents useful approaches for tracking a patient's compliance with a schedule, Burrows requires container-specific implementations for each type of medicine container. In the Burrows example, the disclosed technique is only applicable to rigid container openings.

U.S. patent application publication 2007/0024465 to Howell et al. titled "Portable Container with Speaker Attached", filed Jul. 22, 2006, describes a bottle having a speaker capable of providing audio signals to remind patients to take substances in the bottle. Howell references that some embodiments include storing a bottle in a bag, but fails to address issues relating detecting when a flexible seal of the bag is opened or closed.

Yet another example includes U.S. patent application publication 2009/0294521 to de la Huerga titled "Interactive Medication Container", filed May 8, 2009. The de la Huerga disclosure describes interactive medication containers that inform a patient or pharmacist about compliance with dosage requirements. Even though de le Huerga contemplates interactive systems for bottles, boxes, or blister packs, de la Huerga also fails to address problems arising from a bag-like container having a flexible opening. The disclosed de la Huerga containers also comprise rigid caps or containers.

Additional examples include U.S. Pat. Nos. 7,295,890 and 7,844,361 both to Jean-Peirre and titled "Prescription Drug Compliance Monitoring System", filed Sep. 25, 2003 and Oct. 30, 2007, respectively. In the Jean-Pierre approach medical dispensers alert patients take medication and gathers compliance data. The dispensers also have rigid openings.

These and all other extrinsic materials discussed herein are incorporated by reference in their entirety. Where a definition or use of a term in an incorporated reference is inconsistent or contrary to the definition of that term provided herein, the definition of that term provided herein applies and the definition of that term in the reference does not apply.

Unless the context dictates the contrary, all ranges set forth herein should be interpreted as being inclusive of their endpoints and open-ended ranges should be interpreted to include only commercially practical values. Similarly, all lists of values should be considered as inclusive of intermediate values unless the context indicates the contrary.

Thus, there is still a need for bag containers having non-rigid openings capable of providing schedule or compliance feedback.

SUMMARY OF THE INVENTION

The inventive subject matter provides apparatus, systems and methods in which a bag can include one or more sensors to detect an opening or a closing of a flexible or non-rigid seal. One aspect of the inventive subject matter includes a sensor equipped bag having a main body that includes a cavity defined by flexible walls. The main body also comprises an opening providing access to the cavity. The main body further comprises a flexible seal assembly attached to a rim portion of the opening where the seal assembly is configured to seal the cavity. Example seal assemblies can include magnets, ziplocks, zippers, draw strings, or other seals. The bags can also include an opener coupled with the seal assembly that opens and closes the mechanical seal upon actuation of the opener by mechanically coupling or decoupling the non-rigid rims of the opening. An electronic assembly, possibly disposed in the bag or in the opener, includes circuitry capable of detecting an opening or closing event when the opener is actuated based on proximity of the opener to an opener sensor. In more preferred embodiments, the opener includes a magnet, or other passive trigger, and the electronic assembly utilizes a Hall Effect sensor to detect proximity of the magnet. Thus, the bag can determine if the bag has been opened or closed indicate possible access to the contents of the bag.

Various objects, features, aspects and advantages of the inventive subject matter will become more apparent from the following detailed description of preferred embodiments, along with the accompanying drawing figures in which like numerals represent like components.

BRIEF DESCRIPTION OF THE DRAWING

FIG. **1**A is a schematic of a medicinal container bag capable of sensing when a flexible seal on the bag is opened or closed.

FIG. **1**B a front view of the bag from FIG. **1**A illustrating a display and an audio I/O port.

FIG. **1**C provides a view where an opener of the bag from FIG. **1**A is moved to partially open the bag.

FIG. **1**D provides a detailed view of a grip or handle for the bag from FIG. **1**A.

FIG. **1**E illustrates a compliance ecosystem in which the bag from FIG. **1**A can exist.

FIG. **2**A illustrates an embodiment of a medicinal container bag with opaque walls.

FIG. **2**B reveals placement of an electronic assembly of the bag from FIG. **2**A.

FIG. **3** presents a detailed isometric view of an electronic assembly.

FIG. **4** illustrates a possible alternative embodiment of an inventive bag.

DETAILED DESCRIPTION

It should be noted that any language directed to a computer should be read to include any suitable combination of computing devices, including servers, interfaces, systems, databases, agents, peers, engines, controllers, or other types of computing devices operating individually or collectively. One should appreciate the computing devices comprise a processor configured to execute software instructions stored on a tangible, non-transitory computer readable storage medium (e.g., hard drive, solid state drive, RAM, flash, ROM, etc.). The software instructions preferably configure the computing device to provide the roles, responsibilities, or other functionality as discussed below with respect to the disclosed apparatus. In especially preferred embodiments, the various servers, systems, databases, or interfaces exchange data using standardized protocols or algorithms, possibly based on HTTP, HTTPS, AES, public-private key exchanges, web service APIs, known financial transaction protocols, or other electronic information exchanging methods. Data exchanges preferably are conducted over a packet-switched network, the Internet, LAN, WAN, VPN, or other type of packet switched network.

One should appreciate that the disclosed techniques provide many advantageous technical effects including providing for detecting of opening or closing events of a non-rigid medical container opening.

The following discussion provides many example embodiments of the inventive subject matter. Although each embodiment represents a single combination of inventive elements, the inventive subject matter is considered to include all possible combinations of the disclosed elements. Thus if one embodiment comprises elements A, B, and C, and a second embodiment comprises elements B and D, then the inventive subject matter is also considered to include other remaining combinations of A, B, C, or D, even if not explicitly disclosed.

As used herein, and unless the context dictates otherwise, the term "coupled to" is intended to include both direct coupling (in which two elements that are coupled to each other contact each other) and indirect coupling (in which at least one additional element is located between the two elements). Therefore, the terms "coupled to" and "coupled with" are used synonymously. Within the context of a networking environment the terms "coupled to" and "coupled with" are used euphemistically to mean "communicatively coupled with" where two or more networked elements are configured to exchange data over a network, possibly via one or more intermediary devices.

FIG. **1**A illustrates one possible embodiment of a contemplated bag **100**, preferably a medicinal container. Bag **100** can be used to store various types of pharmaceuticals including pills, blister packs, injectables, liquid doses, vials, surgical tools, bandages, bottles, syringes, or other types of medicine or dispensers. Bag **100** includes a main body having a cavity defined by flexible walls **150**. Flexible walls **150** allow the bag to accommodate a wide variety of the possible contents.

Contemplated bags **100** also include a flexible seal assembly represented by seal **110** disposed around a rim portion of the cavity opening. In the example shown, seal **110** comprises non-rigid rims capable of forming a zip lock seal. Seal **110** allows the bag to flex, bend, or move even when the bag is sealed. Example the non-rigid rims can include zip-locks (e.g., tongue and groove, interlocking ribs or ridges, etc.), zippers, draw strings, magnets, or other types of seal assemblies. Seal **110** is configured to resist or restrict opening without use of a seal opener **120**. Seals **110** that restrict access to the contents are considered advantageous to allow electronic circuitry represented in as electronic assembly **140** in the bag to log or track actual opening or closing events as discussed later.

Bag **100** can also include opener **120** coupled with seal **110** where opener is capable of opening or closing the seal assembly by coupling or decoupling the non-rigid rims. Thus, opener **120** can shift or slide from one side of bag **100** to open bag **100** by separating the non-rigid rims, or shift or slide from the other side of bag **100** to close bag **100** by joining the non-rigid rims.

Opener **120** can be complementary to the type of seal **110** employed on bag **100**. As illustrated opener **120** is configured to open or close a tongue-groove seal assembly similar to those employed in zip-lock bags. In other embodiments, opener **120** can include a zipper, draw strings, magnets, or other types of openers.

In some embodiments, opener **120** can include a sensor or a sensor trigger that can be used to determine if opener **120** is in an open or closed position, or other position between a completely opened or closed position. Opener **120** can include slots allowing portions of the seal assembly's non-rigid rims to slide through opener **120**. Thus opener **120** can accommodate a flexible seal **110** while also providing an indication that the contents of bag **100** have been accessed.

Tracking an open or close state of bag **100** provides useful information related to ensuring a patient complies with a medicinal regimen. When bag **100** is open, the opening event can be considered to indicative of a use of the contents. Further, the duration of time between the opening event and the closing event can be indicative of a use time. One should appreciate that the non-rigid rims and opener **120** can be configured to detect when bag **100** is partially opened. For example, the non-rigid rims could include resistive stripes. As opener **120** moves along the rims a sensor can measure an electrical resistance between a closed position of opener **120** and a current position of opener **120** where electrical resistance indicates how far opener **120** has moved. Such information can be used to indicate if a specific content has been removed. A large blister pack might require a large opening. Thus, when opener **120** is in position that is sufficient to allow removal of the large blister pack, then the opening event can be considered, at least to some extent, a valid use of the blister pack.

Bag **100** can also incorporate electronic assembly **140** having an opener sensor circuit that is configured to detect proximity of opener **120** to an opener sensor. Electronic assembly **140** can be disposed in the bag as illustrated by the dashed line or disposed in or about opener **120** as illustrated in FIG. **4** discussed below. Electronic assembly **140** can further include sensors, processors (e.g., microcontroller, CPU, ASIC, FPGA, etc.), memory (e.g., RAM, ROM, Flash, solid state drive, etc.), batteries, transceivers, antenna, memory, locks, or other types of components.

Some embodiments also comprise communication activation trigger **130**, possibly a button, coupled with electronic assembly **140**. Upon actuation of communication activation trigger **130**, electronic assembly **140** can construct a message and send the message to a remote computing device (e.g., communication hub, router, remote server, etc.). Consider a bag storing doses of a prescription. Based on the number of opening or closing events detected due to motion of opener **120**, electronic assembly **140** can track at least can estimated number of doses used. If the estimated number of doses, or other information, satisfies refill criteria, then communication activation trigger **130** can provide an indication that a refill is due. Alternatively, a patient can actuate communication activation trigger **130** to send a refill message to a pharmacy, or

send other possible messages to remote entities. Refill techniques disclosed in U.S. patent application publication 2010/0270257 to Wachman et al. titled "Medicine Bottle Cap with Electronic Embedded Curved Display", filed Apr. 29, 2010, can be adapted for use with the inventive subject matter disclosed herein.

FIG. **1**B provides a more detailed view of a spine or edge of bag **100** illustrating possible indictors that can be incorporated into bag **100**. Electronic assembly **140** can provide feedback to a patient or consumer via the indicators. In the example shown, bag **100** includes display **142** and audio I/O port **144**. Display **142** is shown as two LEDs ports allowing color coded light to be emitted to present compliance information to a user. Of particular note, the LEDs are positioned on top of the spine and on a forward-facing portion of the spine. Such an approach is considered advantageous because the LEDs can be observed when bag **100** is positioned in different orientations relative to a user, possibly where multiple bags **100** are stacked on top of each other or placed in a shelf in a vertical position. Audio I/O port **144** can comprises a speaker capable of providing auditory information to the consumer. Further, audio I/O port **144** can include a microphone in embodiments supporting bi-directional voice communications (e.g., VoIP, SIP, H.323, etc.). Other types of indicators can include a tactile display capable of generating textures (e.g., Braille, etc.), e-ink displays, LCD displays, LED displays as shown, or other types of indicators.

The indicators illustrated in FIG. **1**B are positioned on a corner of the bag along one spine or edge. Still, the displays could be placed at other locations about the bag. For example, an e-ink display or other flexible display can be positioned on an external surface of the bag where it can be read by the consumer possibly on walls **150**.

FIG. **1**C provides a more detailed view of bag **100** and operation of opener **120**. In this example, opener **120** includes trigger **146**, a magnet for example, which can be used to trigger a complementary opener sensor monitored by electronic assembly **140**. Electronic assembly **140** can comprise opener sensor, or an interface to the opener sensor, which detects opening or closing events upon actuation of opener **120** along the non-rigid rims based on proximity opener **120** to the sensor. For example, the sensor can remain stationary with respect to walls **150** and as opener **120** moves away from the sensor, the senor can detect the position of opener **120**. One aspect of an opener sensor can include a Hall Effect sensor to detect proximity of the magnet in the opener **120**. Other types of triggers can include passive triggers (e.g., magnets, RFID chips, etc.) or active triggers. Example active triggers can include mechanical (e.g., mechanical switch on a zipper, etc.) or electrical components that actively engage with electronic assembly **140** to track opener actuation events.

Opener actuation events include a broad spectrum of information relating to opener **120**. In a basic form, electronic assembly **140** can simply detect when opener **120** shifts between a closed position, possibly based on proximity relative to an opener sensor, and a closed position. In more complex embodiments, electronic assembly **140** can track many other attributes or properties of opener actuation events. Opener attributes can include opener position relative to an edge of the bag, force or grip pressure applied to the opener, rate at which the opener is moved, duration of use, relative position to closed position, or other sensed data. The sensed or measured opener attributes provide information indicative of how a consumer or patient interacts with bag **100**. For example, an elderly person might have difficulty gripping opener **120**, thus might require further assistance as indicated by a piezoelectric sensor. Such data can be transmitted to remote or external computing devices for further analysis via a transceiver coupled with electronic assembly **140**.

Bag **100** can also include a lock, possibly disposed within opener **120** or electronic assembly **140**, which locks opener **120** into a closed position. When scheduling criteria is met, electronics assembly **140** can unlock opener **120** to allow access to the contents stored within the bag **100**. The lock could include a mechanical lock that physical holds opener **120** in a closed position. Alternatively, the lock could include a magnetic lock that electro-magnetically keeps opener **120** in a closed position. In such an embodiment, electronic assembly **140** can disengage the magnetic lock as necessary.

As illustrated in FIG. **1**D, bag **100** can include one or more bag identifiers (e.g., user name, symbol, logo, owner name, prescription number, GUID, UUID, MAC address, network address, etc.), which can be used to differentiate one bag from another. In the example shown, a bag identifier can be inserted into indentation **162** of grip **160** associated with bag **100**. For example, a marker or other item can be sized or dimensions to insert into identification **162**. The marker preferably includes symbols or colors that distinguish bag **100** from other bags, or that allow for identification by individuals suffering from colorblindness or blurred vision. Further, the markers can communicatively couple with electronic assembly **140** (e.g., RFID tag, memory, etc.) to allow electronic assembly **140** to obtain an identifier from the marker, thus allowing electronic assembly **140** to notify remote computing devices (e.g., base stations, servers, services, cell phones, etc) of the bag's identification. The markers can be permanently attached or can be removeably attached to the bag possibly through chemical, mechanical, or magnetic techniques.

In some embodiment, bag **100** can integrate into monitoring, compliance, or scheduling ecosystem **180** as illustrated in FIG. **1**E. Electronic assembly **140** of bag **100** can include a transceiver and antenna through which it can exchange medical or other type of compliance or scheduling data with compliance monitor **190**. The example illustrates bag **100** wirelessly exchanges data with hub **112**, which in turn exchanges data over network **115** (e.g., the Internet, WAN, LAN, VPN, cellular, etc.) with compliance monitor **190**. Example wireless protocols suitable for use with bag **100** include 802.11, WiMAX, Bluetooth, Zigbee, cellular, RF, IrDA, or other wireless protocols.

Hub **112** can be considered an optional element in ecosystem **180**. For example, bag **100** could include a cellular radio capable of establishing a connection with compliance monitor **190** over a cellular network **115**. It is contemplated that most market-relevant implementations will include hub **112**, which would likely be substantially local to the locale where bag **100** will be used. In such cases, hub **112** could include a wireless router, a dedicated communication hub, a game console, a set top box, a tablet or cell phone, or other suitably adapted computing device.

Compliance monitor **190** can also take on different forms. In some embodiments, compliance monitor **190** can include a for-fee service providing access to servers capable of aggregating data from bag **100** in database **195**. Based on notification criteria, monitor **190** can contact other third party entities as desired, or even establish communications with bag **100**. For example, compliance monitor **190** could establish a VoIP session with user via bag **100**.

FIGS. **2**A and **2**B illustrate another embodiment of bag **200** where the electronic assembly **140** is disposed within shell **248** on the inside of the bag. In FIG. **2**B the electronic assembly is revealed from beneath the shell. Further, bag **200** com-

prises opaque walls **250**. Opaque walls **250** can be advantageous in circumstances where medicinal contents would be light sensitive.

FIG. **3** presents a more detailed view of a possible arrangement for an electronic assembly **340**. Electronic assembly **340** is disposed within a bag and comprises sufficient elements to collect usage data and transmit data to an external data store. Electronic assembly **340** can include one or more of printed circuit board (PCB) **343**, speaker **345**, batter **344**, or other components. For example PCB **343** can be populated with a microcontroller and memory coupled with other interfaces or communication elements. The memory (e.g., flash, ROM, RAM, SSD, memory card, micro hard disk, etc.) can store software instructions that configure the microcontroller to perform actions representative of the roles or responsibility of the bag as discussed herein. Additional components coupled with PCB **343** can include an opener sensor or sensor interface (e.g., Hall Effect sensor, RFID reader, etc.), transceivers or PHYs that enable wired or wireless communications, an antenna interface, a display interface capable of presenting information via a display (e.g., LEDs, LCDs, e-Ink, etc.), or other components. Such features are considered well within the ability of one skilled in the art.

FIG. **4** presents alternative bag **400** as an example of the breadth of possible applications of the inventive subject matter. For example, bag **400** can be sized and dimension according to different purposes. Bag **400** can be wider, thinner, longer, shorter, deeper, or have other dimensions. Further, bag **400** can be configured to fold over itself in a wallet-like fashion.

Of particular note, electronic assembly **440** is illustrated as being external to bag **400** where electronic assembly **440** is detachable from bag **440**. In the example shown, electronic assembly **440** clips, or possibly locks, onto opener **420**. In such an embodiment, the non-rigid rims or walls of bag **440** could include a passive trigger element (e.g., magnet) while electronic assembly **440** includes an opener sensor, which moves along with opener **420**. Electronic assembly **440** can also comprise battery tray drawer **449** through which a user can replace batteries of electronic assembly **440**.

In embodiments having a detachable electronic assembly **440**, electronic assembly **440** can mate with one or more physical interfaces, possibly via a multi-pin cabled connector. Thus, a user can insert the electronic assembly **440** into a receptacle, possibly having a hard shell, and plug the assembly into the interface. The interfaces can then provide electronic access to sensors, displays, or other active components associated with the bag.

Bags can include see-through panels allowing a user to observe contents within the bag. In some embodiments, the see-through panels can comprise UV filtering materials to prevent light exposure to the contents. Contemplated bags can be made from multiple materials include injection molded parts, canvas, brushed aluminum, or other materials.

Many additional features can also be incorporated into the contemplated bags. Bags can be equipped with one or more environmental control features that ensure the contents remain within desirable environmental conditions. Bags can include humidity controls, temperature controls (e.g., heaters or coolers), gas filters, UV filters, or other environmental controls.

Contemplated bags are also robust against environment conditions. Preferred materials protect the electronic assembly from temperature extremes (e.g., freeze—thaw events, etc), punctures, shock, or other conditions. For example, bags could be made from Kevlar® or other robust materials, could have padding, or multiple seals.

In some embodiments, the electronic assembly can include a card reader. A consumer can swipe a card having an identification code to active or otherwise unlock the bag. The card reader can read the identification code (e.g., QR code, bar code, photograph of the user, RFID, magnetic strip, etc.) to determine if the consumer is authorized to access the contents.

Although the inventive subject matter is directed toward bags designed to hold pharmaceuticals, one should appreciate the techniques can be applied to broader markets. Example non-medical containers could include refrigerators, boxes, shopping bags, wallets, purses, pockets, backpacks, or other containers.

It should be apparent to those skilled in the art that many more modifications besides those already described are possible without departing from the inventive concepts herein. The inventive subject matter, therefore, is not to be restricted except in the scope of the appended claims. Moreover, in interpreting both the specification and the claims, all terms should be interpreted in the broadest possible manner consistent with the context. In particular, the terms "comprises" and "comprising" should be interpreted as referring to elements, components, or steps in a non-exclusive manner, indicating that the referenced elements, components, or steps may be present, or utilized, or combined with other elements, components, or steps that are not expressly referenced. Where the specification claims refers to at least one of something selected from the group consisting of A, B, C . . . and N, the text should be interpreted as requiring only one element from the group, not A plus N, or B plus N, etc.

What is claimed is:

1. A sensor equipped bag comprising:

a main body having an opening and a cavity defined by one or more flexible walls;

a flexible seal assembly comprising non-rigid rims attached to an opening in the main body and configured to seal the cavity by joining the non-rigid rims;

an opener coupled with the seal assembly and capable of opening or closing the seal assembly by coupling or decoupling the non-rigid rim respectively; and

an electronic assembly comprising an opener sensor circuit configured to detect partial opening of the bag, including estimating an opening size, based on resistance measurements between a closed position of the opener and a current position of the opener.

2. The bag of claim **1**, wherein the electronic assembly is disposed within the bag.

3. The bag of claim **1**, wherein the electronic assembly is disposed within the opener.

4. The bag of claim **1**, wherein the opener sensor circuit detects relative proximity of the opener to a closed position.

5. The bag of claim **4**, wherein the opener sensor circuit detects proximity of a magnet disposed within the opener.

6. The bag of claim **5**, wherein the sensor circuit comprises a Hall Effect sensor.

7. The bag of claim **1**, further comprising an opener lock that locks the opener in a closed position.

8. The bag of claim **7**, wherein the electronic assembly comprises a lock circuit that operates the opener lock.

9. The bag of claim **1**, wherein the electronic assembly further comprises a transceiver capable of communicating with an external computer.

10. The bag of claim **9**, wherein the electronic assembly is further configured to exchange sensed bag related data with the external computer.

11. The bag of claim **1**, further comprising electronic indicators coupled with the electronic assembly.

12. The bag of claim **11**, wherein the indicator comprises a visual display.

13. The bag of claim **12**, wherein the visual display comprises at least one of the following: an e-ink display, a liquid crystal display, and a light emitting diode display.

14. The bag of claim **11**, wherein the indicator comprises a speaker.

15. The bag of claim **11**, wherein the indicator comprises a tactile display.

16. The bag of claim **1**, wherein the non-rigid rims comprise a mechanical seal.

17. The bag of claim **16**, wherein the mechanical seal comprises at least one of the following: zipper, zip-lock, and draw string.

18. The bag of claim **1**, wherein the non-rigid rims comprises magnetic seal.

19. The bag of claim **1**, wherein the non-rigid rims attach to an edge portion of the opening.

20. The bag of claim **1**, wherein the electronic assembly further comprises a communication activation trigger.

21. The bag of claim **20**, wherein the communication activation triggers comprises a button.

22. The bag of claim **20**, wherein the electronic assembly is configured to transmit a message to a remote computing device upon actuation of the communication activation trigger.

23. The bag of claim **1**, wherein the electronic assembly is configured to be user detachable.

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